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SUMMARIES OF PRE-CAMBRIAN LITERATURE OF NORTH AMERICA

EDWARD STEIDTMANN
University of Wisconsin

V. THE EASTERN PART OF THE UNITED STATES

During the period covered by these summaries, the following United States Survey quadrangle areas containing pre-Cambrian rocks have been mapped: the Raritan quadrangle of New Jersey, the Tolchester quadrangle of Maryland, and the Ellijay quadrangle of Georgia. The New York State Museum has published several papers on Adirondack areas. The Federal Survey has published Emerson's bulletin on the "Geology of Massachusetts and Rhode Island."

One of the most notable advances is the determination of the pre-Cambrian age of the Wissahickon mica gneiss of southeastern Pennsylvania by Bliss and Jonas. In Vermont, the unconformable contact between Cambrian and pre-Cambrian has been more clearly defined by Dale and by Keith. The Ocoee group in the south is now placed by the Federal Survey with the Cambrian. This is still largely a matter of arbitrary decision. The apparently conformable gradation of Ocoee into Cambrian is interpreted by Keith and associates as evidence of the Cambrian age of the Ocoee. The lack of fossils in the Ocoee has been emphasized by Van Hise and Leith as a pre-Cambrian trait.

The Raritan quadrangle[1] lies in both the Appalachian and Coastal plain provinces of northern New Jersey. For purposes of mapping, the pre-Cambrian rocks of the quadrangle are classified as the Franklin limestone, Pochuck gneiss, and graphite schists, all of sedimentary origin. The Byram gneiss is a gray granitoid igneous rock composed of microcline, microperthite, quartz, and

[1] W. S. Bayley, R. D. Salisbury, and H. B. Kummel, "Description of the Rariton Quadrangle, New Jersey," *U.S. Geol. Surv., Geol. Atlas*, U.S. Raritan Folio (No. 191) (1914). 32 pp., 21 figs., 5 maps, section sheet.

hornblende with a little pyroxene and biotite. The constituents of the Losee gneiss are quartz, oligoclase, pyroxene, and some hornblende and biotite. The Pochuck gneisses are mostly of unknown origin, but in part are igneous. They are dark-colored rocks composed of pyroxene, hornblende, oligoclase, and magnetite. The stratigraphic relations of the pre-Cambrian rocks have not been worked out. Their classification is lithological. They are believed to be related to the Grenville series of the Adirondacks and southeastern Canada.

Bayley[1] reports that the pre-Cambrian rocks of the highlands of New Jersey include a series of limestone, quartzites, conglomerates, slates, and micaceous schists whose stratigraphic succession is uncertain. They are surrounded by older and in part igneous gneisses.

Bliss and Jonas[2] conclude that the Wissachickon mica gneiss of the Doe Run and Avondale region of southeastern Pennsylvania is of pre-Cambrian age and is separated by a thrust fault from Ordovician limestone.

Cushing and Ruedemann[3] describe the Saratoga Springs area which lies in the eastern central portion of New York state. It includes portions of the Adirondack highlands, New England plateau and the Champlain downwarp. The pre-Cambrian rocks include Grenville sediments intruded by Laurentian granite. Later intrusions of anorthosite, syenite, granite, and gabbro followed in the order named. The Grenville sediments consist chiefly of a variety of schists probably representing metamorphosed muds. Associated with them is a belt of quartzite with some limestone lenses. The schistosity and bedding of the sediments are inferred to be parallel. The schistosity strikes east and west and dips southward at a low angle rarely reaching 40°.

[1] W. S. Bayley, "The Pre-Cambrian Sedimentary Rocks in the Highlands of New Jersey," *Congrès Geologique International.* (XII Session Canada, 1914, pp. 325-34.)

[2] Eleanora F. Bliss and Anna I. Jonas, "Relation of the Wissahickon Mica Gneiss to the Shenandoah Limestone and Octoraro Schist of the Doe Run and Avondale Region, Chester County, Pennsylvania," *U.S. Geol. Surv., Prof. Paper 98* (1916), pp. 9–34, 3 pls., 3 figs.

[3] H. P. Cushing and H. Ruedemann, "Geology of Saratoga Springs and Vicinity," *New York State Museum, Bull. No. 169,* 177 pp., 17 figs., 3 maps.

Dale[1] traced the boundary of the pre-Cambrian and the Cambrian rocks of Vermont for a distance of 60 miles and finds them to be structurally discordant and unconformable. The pre-Cambrian rocks include various granite gneisses, aplite gneiss, metamorphic arkoses, quartzite, conglomerate with pebbles of quartzite, albitic sericitic schists, and graphitic sericitic schist.

Eaton[2] states that the pre-Cambrian rocks of South Mountain, Pennsylvania, near 40° 20′ north latitude and meridian 76° 10′ west longitude, consist mainly of granite, diorite and gabbro gneisses cut by granite pegmatites. These gneisses probably correspond in age and composition to the Losee, Byram, and Pochuck gneisses of eastern Pennsylvania and New Jersey.

Emerson[3] recognizes two belts of pre-Cambrian rocks in Massachusetts, a western belt forming the backbone of the Green Mountains, the eastern belt extending from Rhode Island through Worcester and Essex counties, Massachusetts. The oldest rock in the western belt is the Hinsdale gneiss, a coarse granitoid gneiss including beds of limestone, quartzite, micaceous graphitic schists. Coarse feldspathic rocks locally replace the limestones. Hornblendic and fibrolitic rocks are also included in the Hinsdale gneiss. In the upper portion of the Hinsdale gneiss is the Cole Brook limestone, a coarse magnesian limestone, highly metamorphosed and about 600 feet thick. A more quartzose gneiss than the Hinsdale is called the Washington gneiss. The dominantly igneous pre-Cambrian rocks of western Massachusetts include the Stanford granite gneiss, titanite-diopside, diorite aplite, Lee quartz diorite, Becket granite gneiss, and dunite.

The oldest pre-Cambrian rocks in the eastern belt is the Northbridge granite gneiss. With apparent unconformity, it is overlain successively by the Westboro quartzite and the Marlboro formation, both doubtfully pre-Cambrian. The latter is a biotite schist.

[1] T. Nelson Dale, "The Algonkian-Cambrian Boundary East of the Green Mountain Axis in Vermont," *Am. Jour. Sci.*, 4th Ser., Vol. XLII (1916), pp. 120–24, 1 fig.

[2] H. N. Eaton, "The Geology of South Mountain at the Junction of Berks, Lebanon, and Lancaster Counties, Pennsylvania," *Jour. Geol.*, Vol. XX (May–June, 1912), pp. 331–43, 2 figs.

[3] B. K. Emerson, "Geology of Massachusetts and Rhode Island," *U.S. Geol. Surv., Bull. 597* (1917), 289 pp., 10 pls., 2 figs.

Fenner[1] advocates the theory of the origin of certain gneisses by injection.

Katz[2] tentatively assigns certain quartzites, slates, and schists of southwestern Maine to the Algonkian because of their lithologic resemblance and area and structural relationship to the Westboro quartzite and Marlboro formation of eastern Massachusetts.

Keith[3] has traced an unconformity at the base of the Cambrian along the west border of the Green Mountains, and concludes that certain older sediments beneath the unconformity are properly classed as Algonkian.

La Farge and Phalen[4] follow Keith in placing the Ocoee group of the southern Appalachians in the Cambrian. In the Ellijay quadrangle of northern Georgia they recognized several groups of pre-Cambrian rocks, all of which they classify as Archean.

The most abundant types comprise an older complex of acid schists and gneisses whose origin is doubtful, and a younger group of areally less extensive basic gneisses and schists, mostly dioritic gneiss which is intrusive into the older complex. The first is known as the Carolina gneiss, the latter as the Roan gneiss. Intimately associated with the Roan gneess, are small masses of pyroxenite and dunite which are probably intruded into the Roan gneiss. Both the Roan and the Carolina gneiss are intruded by small masses of granite believed to be Archean in age.

Martin[5] recognizes a Grenville series and post-Grenville intrusives in the Canton quadrangle of northern New York. The Grenville includes limestones, garnet, and siliceous gneisses, quartzites and quartz schist and amphibolite. The post-Grenville

[1] C. N. Fenner, "Mode of Formation of Certain Gneisses in the Highlands of New Jersey" (Abstract), *Geol. Soc. Am. Bull.*, Vol. XXV, No. 1 (March 30, 1914), pp. 44–45.

[2] F. J. Katz, "Stratigraphy in Southwestern Maine and Southeastern New Hampshire," *U.S. Geol. Surv., Prof. Paper 108* (1918), pp. 165–77.

[3] A. Keith, "A Pre-Cambrian Unconformity in Vermont," *Geol. Soc. Am. Bull.*, Vol. XXV, No. 1 (1914), pp. 39–40.

[4] L. La Farge and W. C. Phalen, "Georgia, North Carolina, Tennessee," *Ellijay Folio, No. 187* (1913), 17 pp., 4 maps.

[5] James C. Martin, "The Pre-Cambrian Rocks of the Canton Quadrangle," *New York State Mus., Bull. No. 185* (1916), 112 pp., 20 pls., 31 figs., maps.

intrusives listed are gabbro-amphibolite, granite gneiss, and pegmatite dikes.

Miller[1] gives the following classification of the pre-Cambrian rocks in the region of Bethlehem, Pennsylvania:

Algonkian	Franklin limestone
	Vera Cruz graphitic schist
Undifferentiated pre-Cambrian	Acid and basic igneous and sedimentary gneisses cut by dikes of basalt and pegmatite

Miller[2] and others describe the pre-Cambrian rocks of the Tolchester quadrangle east of Baltimore. The pre-Cambrian rocks include the acid Baltimore gneiss and the Wissahickon gneiss, both believed to be largely sedimentary. Their age relations are uncertain. These rocks are intruded by pre-Cambrian granite, gabbro, peridotite, and pyroxenite.

Miller[3] ascribes the foliation of the Grenville series of New York mainly to recrystallization caused by heat and pressure accompanying the upwelling of magmas, and only to a very minor degree to lateral compression. Low dips, parallelism between bedding and foliation, and general absence of small folds are the principal facts on which this view is based. The foliation of the granite syenite series, he thinks, is an original flow and crystallization structure. The same view is taken of the granulated anorthosite and gabbro phases.

Peck[4] states that the pre-Cambrian rocks of Chestnut and Marble hills in Northampton County, Pennsylvania, consist of a lower granitoid, gneissose series, overlain by a highly metamor-

[1] B. L. Miller, "The Mineral Pigments of Pennsylvania," *Pennsylvania Topog. and Geol. Surv., Rept. No. 4* (1911), 101 pp., 29 pls., 9 figs.

[2] B. L. Miller, E. B. Mathews, A. B. Bibbins, and H. P. Little, "Description of the Tolchester Quadrangle, Maryland," *U.S. Geol. Surv., Geol. Atlas*, Tolchester Folio (No. 204) (1917), 15 pp., 3 pls., maps and illus., 3 figs.

[3] W. J. Miller, "Origin of Foliation in the Pre-Cambrian Rocks of Northern New York," *Jour. Geol.*, Vol. XXIV (1916), pp. 587–619, 1 fig.

[4] F. B. Peck, "Preliminary Report on the Talc and Serpentine of Northampton County and the Portland Cement Materials of the Lehigh District, Pennsylvania," *Pennsylvania Topog. and Geol. Surv., Rept. No. 5* (1911), 65 pp., 17 pls. (incl. geol. map), 9 figs.

phosed series of rocks which vary widely in character, and include beds of limestone and dolomite.

Wherry[1] states that the pre-Cambrian rocks of Pennsylvania occur in three distinct belts: (1) the Catoctin belt extending southwest from Harrisburg into Maryland; (2) the Highland belt extending from a point about 40 miles east of Harrisburg and crossing the Delaware River at Easton; (3) the Piedmont Belt which stretches from Philadelphia to Trenton, New Jersey. About half of the pre-Cambrian rocks of the Highland belt are of sedimentary origin. The latter include crystalline limestones, quartz, mica schists, graphite-bearing quartzite, and amphibolitic gneiss, the latter being areally the most important. The principal facts on which belief in sedimentary origin of these rocks is based, include high silica and alumina content, high carbonate content, rounded zircons, the great longitudinal extent of the gneiss laminae, and the greater age of the laminae as compared with granitic intrusions of the region.

[1] E. T. Wherry, "Pre-Cambrian Sedimentary Rocks in the Highland of Eastern Pennsylvania," *Geol. Soc. Am. Bull.*, Vol. XXIX (1918), pp. 375–92.

[*To be concluded*]